IN THE TITLE

Please replace the present title with the following:

INTERFEROMETRIC SOURCE OF MULTI-COLOR, MULTI-BEAM ENTANGLED PHOTONS WITH MIRROR AND MIXER

IN THE ABSTRACT

Please replace the present abstract with the following:

ABSTRACT OF THE DISCLOSURE

Systems and methods are described for an interferometric source of multi-color, multi-beam entangled photons. ~~A method includes: downconverting a beam of coherent energy to provide a beam of multi-color entangled photons; converging two spatially resolved portions of the beam of multi-color entangled photons into a converged multi-color entangled photon beam; changing a phase of at least a portion of the converged multi-color entangled photon beam to generate a first interferometeric multi-color entangled photon beam; and combining the first interferometric multi-color entangled photon beam with a second interferometric multi-color entangled photon beam within a single beamsplitter.~~ An apparatus includes: a multi-refringent device optically coupled to a source of coherent energy, the multi-refringent device providing a beam of multi-color entangled photons; a condenser device optically coupled to the multi-refringent device, the condenser device i) including a mirror and a mixer and ii) converging two spatially resolved portions of the beam of multi-color entangled photons into a converged multi-color entangled photon beam; a tunable phase adjuster optically coupled to the condenser device, the tunable phase adjuster changing a phase of at least a portion of the converged multi-color entangled photon beam to generate a first interferometeric multi-color entangled photon beam; and a beam splitter optically coupled to the condenser device, the beam splitter combining the first interferometeric multi-color entangled photon beam with a second interferometric multi-color entangled photon beam.

IN THE SPECIFICATION:

Please replace the first full paragraph of page 6 with the following paragraph:

Within this application several publications are referenced. Full citations for these, and other, publications may be found at the end of the specification immediately preceding the claims after the section heading References. The disclosures of all these publications in their entireties are hereby expressly incorporated by reference herein for the purpose of indicating the background of the invention and illustrating the state of the art. The disclosure of this application is similar to U.S. Ser. No. 09/938,843, filed ~~July~~ August 24, 2001, now pending, ~~(Attorney Docket No. UBAT:031US)~~ the entire contents of which are hereby expressly incorporated by reference herein for all purposes.

IN THE CLAIMS:

Please amend the claims as follows:

Please cancel claims 10 and 14 without prejudice or disclaimer.

1. (Currently Amended) A method, comprising:

downconverting a beam of coherent energy to provide a beam of multi-color entangled photons;

converging two spatially resolved portions of the beam of multi-color entangled photons into a converged multi-color entangled photon beam by directing a first of the two spatially resolved portions of the beam of multi-color entangled photons toward a mirror and directing a second of the two spatially resolved portions of the beam of multi-color entangled photons toward a mixer, wherein the first of the two spatially resolved portions of the beam of multi-color entangled photons is reflected by the mirror toward the mixer and mixed with the second of the two spatially resolved portions of the beam of multi-color entangled photons by the mixer to define the converged multi-color entangled photon beam;

changing a phase of at least a portion of the converged multi-color entangled photon beam to generate a first interferometeric multi-color entangled photon beam; and

combining the first interferometric multi-color entangled photon beam with a second interferometric multi-color entangled photon beam within a single beamsplitter.

2. (Currently Amended) The method of claim 1, wherein the first interferometic multi-color entangled photon beam and the second interferometric multi-color entangled photon beam are combined within a single interference zone within the single beam splitter.

3. (Original) The method of claim 1, wherein combining includes erasing energy and momentum characteristics from both the first interferometric multi-color entangled photon beam and the second interferometric multi-color entangled photon beam.

4. (Currently Amended) The method of claim 1, further comprising, after combining, splitting the first interferometric multi-color entangled photon beam and the second

interferometric multi-color entangled photon beam within the single beamsplitter.

5. (Original) The method of claim 4, wherein splitting yields a first output beam of multi-color entangled photons and a second output beam of multi-color entangled photons.

6. (Original) The method of claim 5, further comprising:

splitting the first output beam of multi-color entangled photons into a first component multi-color photon beam and a second component multi-color photon beam; and

splitting the second output beam of multi-color entangled photons into a third component multi-color photon beam and a fourth component multi-color photon beam.

7. (Original) The method of claim 6, further comprising:

detecting a first characteristic of the first component multi-color photon beam;

detecting a second characteristic of the second component multi-color photon beam;

detecting a third characteristic of the third component multi-color photon beam; and

detecting a fourth characteristic of the fourth component multi-color photon beam.

8. (Original) The method of claim 5, further comprising:

shading the first output beam of multi-color entangled photons with a first energy position defining slit; and

shading the second output beam of multi-color entangled photons with a second energy position defining slit.

9. (Original) A computer program, comprising computer or machine readable program elements translatable for implementing the method of claim 1.

10. (Cancel)

11. (Original) An electronic media, comprising a program for performing the method of claim 1.

12. (Original) An apparatus, comprising the electronic media of claim 11.

13. (Currently Amended) An apparatus, comprising:

a multi-refringent device optically coupled to a source of coherent energy, the multi-refringent device providing a beam of multi-color entangled photons;

a condenser device optically coupled to the multi-refringent device, the condenser device i) including a mirror and a mixer and ii) converging two spatially resolved portions of the beam of multi-color entangled photons into a converged multi-color entangled photon beam;

a tunable phase adjuster optically coupled to the condenser device, the tunable phase adjuster changing a phase of at least a portion of the converged multi-color entangled photon beam to generate a first interferometeric multi-color entangled photon beam; and

a beam splitter optically coupled to the condenser device, the beam splitter combining the first interferometeric multi-color entangled photon beam with a second interferometric multi-color entangled photon beam,

wherein i) a first of two spatially resolved portions of the beam of multi-color entangled photons is directed toward the mirror, ii) a second of two spatially resolved portions of the beam of multi-color entangled photons is directed toward the mixer and iii) the first of the two spatially resolved portions of the beam of multi-color entangled photons is reflected by the mirror toward the mixer and mixed with the second of the two spatially resolved portions of the beam of multi-color entangled photons by the mixer to define the converged multi-color entangled photon beam.

14. (Currently Amended) The apparatus of claim 13, wherein the ~~condenser device includes a~~ mirror includes a ring mirror and ~~a~~ the mixer includes a ring mixer.

15. (Currently Amended) The apparatus of claim 13, further comprising another condenser device optically coupled to the multi-refringent crystal, the another condenser device i) including a mirror and a mixer and ii) converging two spatially resolved portions of another beam of multi-color entangled photons into another converged multi-color entangled photon beam.

16. (Original) The apparatus of claim 15, further comprising a fixed phase adjuster optically coupled between the another condenser device and the beam splitter, the fixed phase adjuster generating the second interferometric multi-color entangled photon beam.

17. (Original) The apparatus of claim 13, wherein the multi-refringent device includes a non-linear optical crystal.

18. (Original) The apparatus of claim 17, wherein the non-linear optical crystal includes a bi-refringent crystal.

19. (Original) The apparatus of claim 17, wherein the non-linear optical crystal includes at least one member selected from the group consisting of LiB_3O_5, KH_2PO_4, KD_2PO_4, $NH_4H_2PO_4$, β-BaB_2O_4, $LiIO_3$, $KTiOPO_4$, $LiNbO_3$, $KnbO_3$, $AgGaS_2$, $ZnGeP_2$, $KB_5O_8 - 4H_2O$, $CO(NH_2)_2$, CsH_2AsO_4, CsD_2AsO_4, $KTiOAsO_4$, MgO : $LiNbO_3$, Ag_3AsS_3, GaSe, $AgGaSe_2$, CdSe, $CdGeAs_2$, $KB_5O_8 - 4D_2O$, CsB_3O_5, $BeSO_4 - 4D_2O$, $MgBaF_4$, $NH_4D_2PO_4$, RbH_2Po_4, RbD_2PO_4, KH_2AsO_4, $NH_4H_2AsO_4$, $NH_4D_2AsO_4$, RbH_2AsO_4, RbD_2AsO_4, $LiCOOH - H_2O$, NaCOOH, $Ba(COOH)_2$, $Sr(COOH)_2$, $Sr(COOH)_2 \cdot 2H_2O$, $LiGaO_2$, α-HIO_3, $K_2La(NO_3)_5 \cdot 2H_2O$, $CsTiOAsO_4$, $NaNO_2$, $Ba_2NaNb_5O_{15}$, $K_2Ce(NO_3)_5 \cdot 2H_2O$, $K_3Li_2Nb_5O_{15}$, $HgGa_2S_4$, HgS, Ag_3SbS_3, Se, Tl_3AsS_3, Te, $C_{12}H_{22}O_{11}$, L-Arginine Phosphate Monohydrate, Deuterated L-Arginine Phosphate Monohydrate, L-Pyrrolidone-2-Carboxylic Acid, $CaC_4H_4O_6 \cdot 4H_2O$, $(NH_4)_2C_2O_4 \cdot H_2O$, m-Bis(amonimethyl)benzene, 3-Methoxy-4hydroxy-benzaldehyde, 2-Furyl Methacrylic Anhydride, 3-Methyl-4-nitropyridine-1-oxide, Thienylchalcone, 5-Nitrouracil, 2-(N-Prolinol-5-nitropyridine), 2-Cyclooctylamino-5-nitropyridine, L-N-(5-Nitro-2-pyridyl) leucinol, $C_6H_4(NO_2)_2$ (m-Dinitrobenzene), 4-(N,N-Dimethylamino)-3-acetaminonitrobenzene, Methyl-(2,4-dinitrophenyl)-aminopropanoate, m-Nitroaniline, N-(4-Nitrophenyl-N-methylaminoacetonitrile, N-(4-Nitrophenyl)-L-prolinol, 3-Methyl-4-methoxy-4-nitrostilbene, and α-SiO_2.

20. (Original) The apparatus of claim 13, further comprising:

a first energy position defining slit optically coupled to the beam splitter; and

a second energy position defining slit also optically coupled to the beam splitter.

21. (Original) The apparatus of claim 20, further comprising:

a first optical separator optically coupled to the first energy position defining slit; and

a second optical separator optically coupled to the second energy position defining slit.

22. (Original) The apparatus of claim 21, wherein the first optical separator includes at least one member selected from the group consisting of a cold mirror and a cold filter.

23. (Original) The apparatus of claim 21, wherein the second optical separator includes at least one member selected from the group consisting of a cold mirror and a cold filter.

24. (Original) The apparatus of claim 21, further comprising:

a first optical detector optically coupled to the first optical separator;

a second optical detector also optically coupled to the first optical separator;

a third optical detector optically coupled to the second optical separator; and

a fourth optical detector also optically coupled to the second optical separator

25. (Original) The apparatus of claim 24, further comprising:

a signal processing unit optically coupled to the first optical detector, the second optical detector, the third optical detector and the fourth optical detector;

a computer program, running on the signal processing unit; and

a graphical user interface coupled to the signal processing unit.

26. (Original) The apparatus of claim 13, further comprising the source of coherent energy.

27. (Original) The apparatus of claim 26, further comprising a converging lens optically coupled between the source of coherent energy and the multi-refringent device.

IN THE DRAWINGS:

Please substitute the attached four Replacement Sheet(s) for its(their) corresponding drawing sheet(s) in this Application.

REMARKS

Favorable reconsideration of this application is requested in view of the foregoing amendments and the following remarks. Claims 1-9, 11-27 are pending in the application. Claim 10 is canceled without prejudice or disclaimer.

The claims are amended in order to more clearly define the invention, support for which is found in the figures and related parts of the specification. Specifically, support for the condenser device including a mirror and a mixer is found in the paragraph bridging pages 11-12; at lines 14-24, page 14; lines 13-17, page 19; and lines 19-21, page 23 of the specification as originally filed; in claim 14 as originally filed; and in Figs. 1, 4 and 7a-7b as originally filed. Support for the recited functions of the mirror and mixer is found in the paragraph bridging pages 11-12; at lines 14-24, page 14; lines 13-17, page 19; and lines 19-21, page 23 of the specification as originally filed; and in Figs. 1, 4 and 7a-7b as originally filed. Support for the recitation of a ring mirror and a ring mixer in claim 14 is found at lines 13-17, page 19 of the specification as originally filed and in Figs. 7a-7b. Claims 2 and 4 are amended merely to correct two minor typographical errors.

The specification is amended to more clearly identify a related application. The title is amended to more particularly name the claimed invention. The abstract is amended to more concisely summarize the presently claimed invention.

At page 2 of the Action, the Examiner objects to the abstract. The abstract of the disclosure has been edited to be less than 150 words.

Accordingly, withdrawal of this objection is respectfully requested.

At page 2 of the Action, the Examiner objects to the drawings as informal. The Examiner's careful consideration of the drawings is appreciated. Applicant submits herewith

one copy of four sheets of formal drawings that overcome the objection to the drawings as set forth by the Examiner.

Accordingly, withdrawal of this objection is respectfully requested.

Claim 10 was rejected under 35 USC 101 as directed to non-statutory subject matter. As noted above, claim 10 is cancelled without prejudice or disclaimer.

Accordingly, withdrawal of this rejection is respectfully requested.

Claims 1-5, 10, 13-19 and 26-27 were rejected under 35 USC 102(b) as anticipated by Larchuk et al. (Physical Review Letters 1993). Again, as noted above, claim 10 is cancelled without prejudice or disclaimer.

The presently claimed invention requires that a converged multi-color entangled photon beam be defined by a mirror and a mixer. Referring to the paragraph bridging pages 11-12 of this application as originally filed, the condenser device can include wavelength selective mirrors and/or wavelength selective filters. Referring to lines 14-24, page 14; lines 13-17, page 19; and lines 19-21, page 23 of the specification and Figs. 1, 4 and 7a-7b of this application, the two spatially resolved portions of the beam of multi-color entangled photons correspond to two different colors (wavelengths/energies). The claimed mirror reflects the first of these two spatially resolved portions and the claimed mixer reflects the second of these two spatially resolved portions, while being transparent to the first. The Larchuk reference does not disclose or suggest a converged multi-color entangled photon beam be defined by a mirror and a mixer. Accordingly, withdrawal of this rejection is respectfully requested.

Claims 1-7, 10, 13-19 and 26-27 were rejected under 35 USC 102(b) as anticipated by Shimizu et al. (1997). Yet again, as noted above, claim 10 is cancelled without prejudice or disclaimer. With regard to claims 1-7, 13-19 and 26-27, the Shimizu reference does not

disclose or suggest a converged multi-color entangled photon beam be defined by a mirror and a mixer.

Accordingly, withdrawal of this rejection is respectfully requested.

Claim 10 was rejected under 35 USC 102(b) as anticipated by any electromagnetic waveform. Once again, as noted above, claim 10 is cancelled without prejudice or disclaimer.

Accordingly, withdrawal of this rejection is respectfully requested.

Claims 9 and 11-12 stand rejected under 35 USC 103 as obvious over Shimizu et al. (1997). Claims 9 and 11-12 depend from claim 1 and the Shimizu reference does not disclose or suggest a converged multi-color entangled photon beam be defined by a mirror and a mixer as now required by claim 1.

Accordingly, withdrawal of this rejection is respectfully requested.

Claims 8 and 20-25 stand rejected under 35 USC 103 as obvious over Kim et al. (Physical Review A- May 2001) in view of Shimizu et al. (1997). The Kim reference does not disclose or suggest a converged multi-color entangled photon beam be defined by a mirror and a mixer.

Accordingly, withdrawal of this rejection is respectfully requested.

Other than as explicitly set forth above, this reply does not include acquiescence to statements by the Examiner. In view of the above, all the claims are considered patentable and allowance of all the claims is respectfully requested. The Examiner is invited to telephone the undersigned (at direct line 512-457-7233) for prompt action in the event any issues remain.

No fee is due for filing this Reply because it is being filed within the shortened statutory period for response as set in the Office Action dated July 3, 2003.

The Commissioner is hereby authorized to charge any fees or credit any overpayments to Deposit Account No. 50-0456 of Gray Cary Ware & Freidenrich, LLP.

Respectfully submitted,

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